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SMART APP FOR PHYSICALLY CHALLENGED PEOPLE USING INTERNET OF THINGS

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ABSTRACT

In this paper, we provide the solution for physically challenged people like hearing impaired people .It is a smart application works for the hearing impaired people. People with hearing loss have move through the activities of daily living at home, at work and in business situations. People may face the difficulty in hearing the environment sounds and identifying the sounds. Our main contribution for the hearing impaired people is to make them understand the type of sounds which is useful to them. The conventional sound recognition techniques are not directly applicable since the background noise and reverberations are high which leads to low performance. A deep neural network which is capable of classifying and predicting the information from unstructured data such as image, text or sounds that makes the machine to get the environmental sounds. In this paper, a deep learning algorithm called CNN(convolution neural network) which classify the sound audio clips. This model will results the accuracy of 80% which is higher than the conventional technique .It achieves good results comparable to other approaches.

Keywords- deep learning; convolution neural network; feature extraction; sound recognition; sound event classification.

I.INTRODUCTION

Sound plays a vital role in everyone's life by sharing the information with other people. Hearing impaired people will feel difficult to understand the sound with background noise. For example, Whoopi Goldberg, a comic writer with hearing loss discovered a portable listening platform for children to prevent from the hearing loss. Sound recognition is the only solution which guide the hearing impaired people to overcome the struggles of hearing the sound.

This Smart app is used for physically challenged people like deaf and dumb people using internet of things and deep learning algorithm.The main aim is to give an alarm in emergency situation for physically challenged people .Alarm is nothing but it is a silent notification for the user. For example, the deaf and dumb people who is working in front of desktop or personal computer, they may not be aware of their surroundings and environment.

This smart app gives an alarm/notification to the user through the desktop/personal computer. If a fire accident happens, then the fire alarm will be on, the application will detect the fire alarm sound and give the notification as fire alarm is detected. By using this notification, the physically challenged people will prevent themselves from the emergency situation. The urban sound 8K datasets is used .

The CNN algorithm will detect the sound and then it will analyze the type of sound.

After analyzing the sound, it will recognize the sound and gives a notification to the user. Within a given area, the system will be able to detect the type of sound. It will get the sound using hardware implementation using Internet of Things. After getting the sound based on deep learning, train the data sets. So based on the dataset it will analyze the type of sound and notify it to the user via notification. It will produce accurate result.

II.METHODOLOGY

The detection and classification of sound is a multilevel process: Sound dataset, Audio preprocessing, Feature extraction, CNN classification model, Hardware implementation, Sound classification, Notification.

Sound Datasets: In this paper the urban sound 8K dataset is used .It contains 8732 recording samples with 10 classes of different sound sources such as: dog bark, car horn, siren etc.Most of the above sound samples have duration of 5-6 seconds. But some of the sound samples can be as short as 3 seconds. The urbansound8K are subdivided into 10 subgroups for 10 fold cross validation. The 8732 sound excerpts are cropped from a smaller number of longer recordings using librosa and it can result in optimistic results. The sub divided 10 folds will avoid the issues and make the results accurate. The urban sound dataset contains .wav format files. To convert the .wav files into matrix of numbers (10X10) matrix [10 sound files] using the python sound file library.

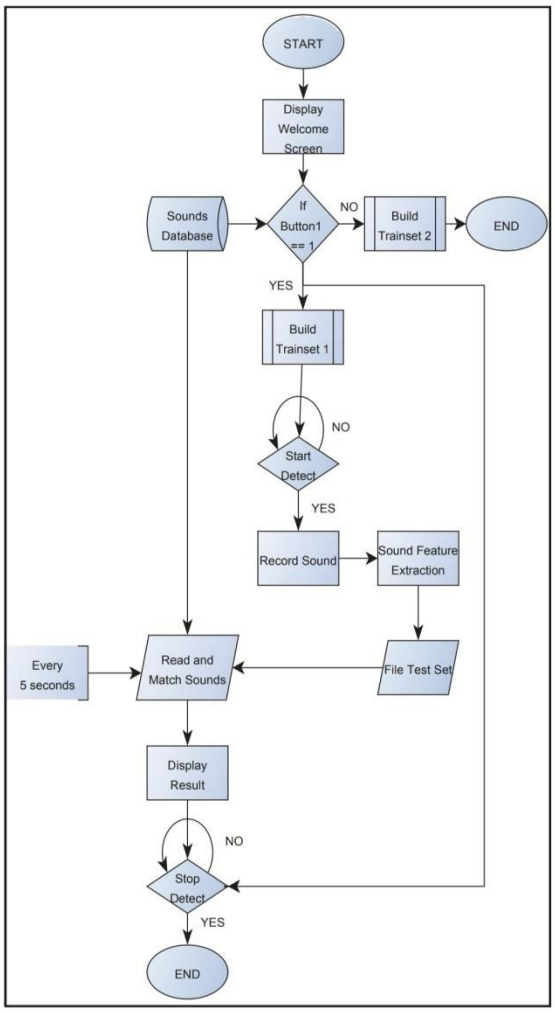

Figure.1

Audio preprocessing: To represent audio clip in .wav files the data need to be preprocessed. For audio processing the librosa library provide useful functionalities. Using librosa, audio files are loaded into a numpy array which consists of amplitudes of the corresponding audio clip. Theses amplitudes are called as sampling rate which is usually 22050Hz or 44100Hz.After loading the audio clip into an array, noisiness should be removed. To suppress the noise in the audio, spectral gating algorithm is used which is implemented using noise reduce python library. In

resulting audio clip the leading and trailing parts are trimmed to get the noise reduced audio file.

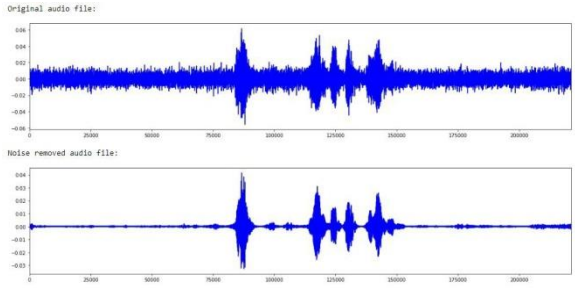

Figure.2

Feature Extraction: In general, without feature extraction, the audio data is not understandable by the classification modal. To make it understand extract the audio features from the preprocessed audio clips.The absolute values of Short Time Fourier Transform (STFT) will be extracted from each audio clip.

1. To calculate STFT, find the window size of STFT using FFT window size.
2.According to the equation, **n_stft=n_fft/2+1**where n_stft is short fourier transform window size and n_fft is fourier transform window size from which STFT frequency bins**f** is calculated.
3. Consider **t** no of audio samples, **f** no of frequency bins in the STFT, **h** is the windows hop length and **w** is the window length.
4. Number of windows is calculated using **1+ (t-w)/h.**
5. For each window,the amplitude of frequency bins ranges from 0 to **sampling _rate/2** which is stored as a 2D array.
6. This 2D array is normalized to get a common loudness level.

CNN Classification Model: From the feature extracted, the modal is trained to classify the audio events. Hence CNN classification modal is used. For classification, convert the data into spectrogram, for which librosa is utilized. After plotting and building a spectrogram of data, implement the two layer neural network which consists of input layer and output layer. The weights are defined by the hidden layer.It is used for mapping between the input and the output layer .The last layer of the neural network is the softmax layer is in the output layer from which the probability distribution for the audio clip is identified. This paper shows that CNN is used to classify the sound clips to the greater accuracy to predict the sound

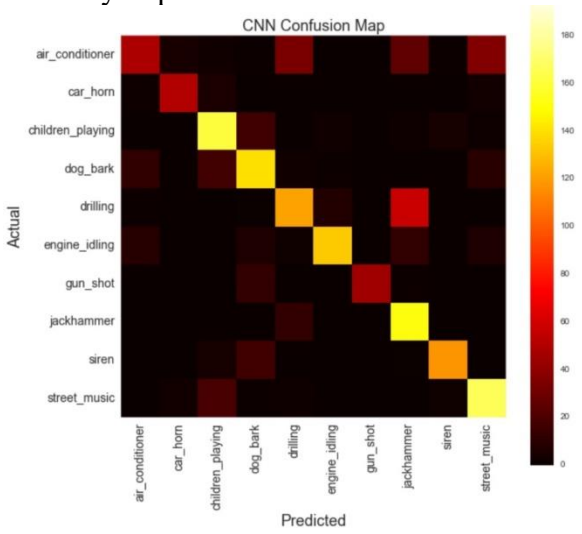

Figure.3

Hardware Implementation: The hardware implementation is used for getting the external sound. The hardware consists of raspberry pi3 and microphone.

Raspberry Pi3:A raspberry pi 3 is an electronic board where it has the special features of recording the particular sound and stores it in memory card when the Wi-Fi is off. If the Wi-Fi is on,it will store the data in cloud. The raspberry pi gives the high

level performance when it is compared to arduino.

Sound classification: The sound is then processed by the classification part of the CNN algorithm and it will analyze the type of sound and then it will notify to the user via notification.

Notification: It will send the notification to the user through desktop or personal computer when particular sound is detected. It will be useful for hearing impaired people.

III.LITERATURE SURVEY

There are different methods of the sound classification using Arduino and various machine learning techniques.

Arushi Singh,L.Ezhilarasi et al[1]have proposed a system which uses sound sensors to detect the sound and then transmit the sound data. They focus on sound pollution monitoring system with sensing the sound using raspberry Pi . A raspberry Pi module interacts with the sensors and processes the sound data and sends the alert to the application. It can detect and monitor sound pollution levels using IOT which further send a mail or SMS to the system. In future work, they planned to implement this concept in the method of machine learning.

Baker Fleurys et al [2] have proposed a system to perform certain task by recognizing the sound in home automation system. The system will generate poor recognition results, when the noisy sounds mixed with the target sound due to occurrence of the sound simultaneously. To solve this problem, this paper produces a framework. The framework consists of the sound verification and the sound separation techniques based on wireless based sensor networks. The applications of Wireless Sensor Network are home automation system, security system, power management.

L. Korhonen, J. Pakka have proposed the health care for the aged persons. The monitoring can be done using the telecommunication in the hospitals to reduce the cost of hospitalization and also to improve the comfort of the patients in the hospital. In this paper the sound is classified and detected in a noisy environment using sound surveillance. There are two stages: one detects the sound and extract the sound from a signal flow. The sound classification is the second stage is to identify the unknown sounds and then it will be validated. The future aim is to find the fusion between the classification and the analysis of the sound in a medical telemonitoring system.

Lin Goldman et al[4] have proposed this system for sensing the human behavior using microphone which reveals the key information. The person's behavior is produced by the key information. The microphone will be present in the modern smart phones or the laptop or pc. The approach used for sensing the sound is supervised learning which is the part of the machine learning. The problem in this system is time consuming and it is restricted

to the various types of sounds. it explored the general sound classification without using explicit supervised training in the smartphone. The supervised techniques will produce better results compared to the fully supervised DS.

F.Pachet and D.Cazaly et al [5] have a proposed the system for classification of audio signals. The characterization shared by its members is music genre. The characterization related to the instrument, structure of the rhythm and the music of the harmonic content. The music genres are explored in a hierarchy from the automatic classification of the audio signals. The timbral texture, rhythmic content and pitch content are the three important feature sets have been proposed. The audio classification is done here. The techniques include in the audio classification are music and non-music sounds. The audio signals are classified into the music, speech and laughter.And it also detects the environmental sounds .The melody extraction is a hard problem which is not solved for general audio using from imperfect melody extraction algorithms. The pattern recognition, sound recognition is contained in the C++ server.

N.Morgan, G.Dahl et al [6] have proposed the system for speech recognition using convolution neural network and hybrid neural network .Hidden Markov model is used to increase the accuracy of speech recognition. Some types of speech variability is accommodated by the convolution neural network structure. It will recognize the speech alone and it is not recognized in the phone. The CNN can be pre trained to improve the performance of the recognition. The speech is recognized in the method of the speech datasets.

Y.Peng,C.Lin et al [7] have proposed the system for sound event classification using semi supervised learning. In this paper, they mainly focus on sound classification in a large datasets., manually labeling the sound data is expensive, so the large amount of sound data will be available to public. It makes use of the semi supervised learning in the approach of the sound analysis. The future work will focus on large unlabeled datasets to detect, analyze and to classify what the sound is.

B.Najali,N.Noury etal [8] has proposed the system for flats to recognize the sound and speech. They placed eight microphones to detect the sound which is trained the environmental sounds. it will automatically analyze and sort the different types of sounds recorded in the flat. This paper produces a complete sound and speech recognition using unsupervised learning real time conditions. After testing the event, it will produce the results for sound recognition is good and produce the accurate results.

Y. LeCun, L. Bottou, Y. Bengio et al [9] have proposed this for environmental sound classification using convolution neural network. Based on the 3 public data sets of environmental and urban sounds are

evaluated and produce the accuracy of the sound. For significant progress in numerous pattern recognition tasks, convolution neural networks are used. The size of the datasets influences the performances of the supervised deep model. Increase in the size of the dataset will improve the performance of the trained models. it will detect the environmental sound using machine learning algorithm which uses convolution neural network.

J. G. Ryan and R. A. Goubran et al [10] have proposed a system for detecting different type of sounds in a given area and determining both the location and type of the sound. For nonspeech audio segments, additional features are computed to perform audio classification, which determines the nature of the sound (e.g., wind noise, closing, footsteps ,door opening or closing, fan noise).it is capable of working in a signal to noise ratio (SNR) and degradation environment is done by using speech/non speech algorithm.This paper proposed a security monitoring instrument that can classify and detect the nature and location of different sounds in a room.

IV.CONCLUSION AND FUTURE WORK

A summary of the performance of the sound detection and classifications of sound in the system is evaluated. From the smart web application for physically challenged people, the sound event classification and detection is proposed using internet of things and machine learning algorithm.

In future work, this web application can be made as a mobile application. Because compared to web app, usage of mobile app is more and it will work efficiently in mobile application and it can also be done using various deep learning algorithm.

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